FINAL REPORT
TREATABILITY STUDY
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

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ldm:df/fitz/fr-3624

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1.0 INTRODUCTION

1.1 Objectives of This Study

The objective of this project is to evaluate the treatment/removal alternatives including solidification and waste minimization through separation, and recommend cleanup goals for the lead and zinc contaminated soil at the Harco Site. The cleanup goals will reflect the need to prevent future migration of the target compounds from the site and to prevent/reverse the contamination of the surface waters adjacent to the Harco Property.

The treatment option recommendations will be based on documented effectiveness of the process and the cost effectiveness of the approach.

The cleanup goals will be based on the United States Environmental Protection Agency (U.S.EPA) established cleanup goals (Office of Solid Waste and Emergency Response, 1990) for lead in soils, achievement of the U.S. EPA Ambient Water Quality Criteria levels for zinc and lead in surface water, and the solubility of the lead and zinc in the matrix that exists on the Harco Site.

1.2 Site Background

The suspected contamination at the Harco Site is a result of the landfilling of metal hydroxide sludge from an electroplating facility. The site is located on Old Mill Road in the city of Wilton, Fairfield County, Connecticut. The nearest residents are located within 0.1 miles north of the site. The Norwalk River is located 0.25 miles due west of the site (Figure 1 - Site Location Map).

The site is a landfill facility on 41.1 acres which had been operating for an unknown number of years and was abandoned in 1982. Metal hydroxide sludge from the Gilbert and Bennett, Inc. facility located in Georgetown, CT, was handled by this facility. In 1970, the volume of metal hydroxide sludge permitted for disposal by the town of Wilton and the State of Connecticut, Water Resources Division, was limited to 800 cubic yards. However, the actual amount of material disposed at the Harco Property site may have exceeded the permit quantity, and the actual amounts are unknown. It was reported by the town of Wilton's Department of Environmental Health in January, 1986 (Wilton DEH, 1986), that the actual disposal exceeded the permitted length of time. Additional areas and materials may have also been landfilled. The basis of this information may be found in background files maintained by the U.S. EPA On-Scene Coordinator (OSC).

The primary contaminants, lead and zinc, were identified during the U.S. EPA Removal Program Preliminary Assessment/Site Investigation (PA/SI) conducted on September 25, 1990 (WESTON, 1990). Lead, a public health threat, was found at concentrations of up to 84,500 milligrams/kilogram (mg/kg) in soil. Zinc, an environmental threat, was found in stream water adjacent to the site at concentrations of up to 9 milligrams per liter (mg/L). A site diagram including the sample stations and analytical results from the January 28, 1992, site visit is shown in Figure 2 (WESTON, 1992).

On March 24, 1992, the U.S. Environmental Protection Agency, Environmental Response Team (U.S. EPA, ERT) Work Assignment Manager and personnel from the Response Engineering and Analytical Contract (REAC) met the U.S. EPA Region I On-Scene Coordinator at the Harco Site and conducted a preliminary site survey. Treatability samples

were collected at four locations (Figure 3) and returned to REAC for subsequent evaluation.

2.0 METHODOLOGY

Four samples from the Harco site were evaluated to determine the most feasible method of solidification that would immobilize the principal contaminants of lead and zinc in each and to evaluate waste minimization by selectively removing uncontaminated gravel and wood fragments.

Throughout this report, the four Harco samples are referred to by the numbers 1, 2, 3 and 4. The corresponding Field Data Sheet numbers are: 1 = 15120; 2 = 15121; 3 = 15122; and 4 = 15075 (Appendix A, Field Data Sheets).

2.1 Particle Size Distribution

The study began by sieving the samples after they had been thoroughly dried to determine the percentage of gravel present that was larger than 16 mm and smaller than 9.5 mm. In order to separate the coarse gravel, the Harco samples were dried, ground, and sieved. To accomplish this, a subsample of approximately 1 kilogram was oven dried at 105° C for 24 hours, and then allowed to cool to room temperature. The hardened soil was broken up with a GeoTest Model EU653 soil grinder. The ground soil was then sieved into three fractions using two US standard sieves with openings of 16 mm and 9.5 mm. Each fraction was weighed and compared to the total mass. The 9.5 mm screen was chosen as it is the smallest size normally used to screen material in these operations. Screening to a finer size is impractical for field scale activities. Once size distribution was determined, a representative specimen of the sample, with a particle size less than 9.5 mm, was analyzed for metals by X-ray fluorescence (XRF). XRF analysis is not applicable to larger, gravel sized material; therefore these sizes were not analyzed.

2.2 XRF Analysis

The instrument used was a portable XRF analyzer Spectrace 9000. The Spectrace 9000 was operated as specified in the Spectrace 9000 manual (Rev. 0.3 Preliminary January 1992).

2.3 Solidification/Stabilization

Solidification was accomplished by adding cement to a sample screened to less than (6.3 mm) one-quarter inch. Water was added, as necessary, to achieve the proper consistency. Three tests were run to determine the optimum ratio of soil to cement needed to meet the requirements of the unconfined compressive strength and lead and zinc concentrations in the TCLP leachate. The three tests consisted of a 15%, a 30%, and a 45% cement-to-soil mixture with a seven-day cure time at 107° F.

In preparation for solidification, a subsample of approximately 1800 grams was screened to less than 6.3 mm (one-quarter inch). The wet sample was allowed to settle for approximately one hour and the water which pooled to the surface was decanted. Each screened subsample was then divided into three portions of approximately 600 grams each and then mixed with a different amount of Portland Type 1 cement (15%, 30%, and 45%) based on the wet weight of the sample. The soil/cement combination was mixed, using an automatic mixer, to the proper consistency. Water was added as needed, and its volume is noted in Table 3 along with other solidification additives.

Each mixture was then placed in 2-inch diameter by 4-inch high plastic solidification molds. Two molds per 600 gram sample portion wer filled for a total of six molds for each sample. The molds were then capped and placed in a moist curing chamber and left undisturbed for seven days at a constant temperature of 107° F. This curing time and temperature resulted in the sample reaching approximately 80% of the strength as a sample cured for twenty-eight days at 70° F. After curing, the solidified samples were allowed to dry at room temperature, and the plastic molds removed. Then, each was tested for unconfined compressive strength in accordance with ASTM D 2166-85.

Unconfined compressive strength was performed on all but two of the solidified samples. The No. 4 samples, with 15% and 30% cement, were not tested because observation showed that these samples were soft and would not retain their shape if removed from the mold. The remaining samples, which appeared to posses sufficient cohesion, were cut from their molds, and their ends were scraped with a razor to form a level surface. The specimen was then placed in the center of the lower platen of the loading device (SoilTest, hand operated, unconfined compression tester Model U-580) and, after the upper platen made contact with the specimen, the deformation dial was zeroed. By turning the handle at a constant rate (four revolutions per minute), a steadily increasing load was applied to the specimen up to the point of failure. Then, by plotting the reading of the load and deflection dials every thirty seconds, it was possible to draw a stress-vs-strain graph (Figures 5 through 8). On completion of the unconfined compressive strength test, the samples were crushed and extracted by Toxicity Characteristic Leaching Procedure (TCLP) in accordance with 40 CFR Part 261. Then the leachate was analyzed for lead and zinc by atomic absorption analysis.

In order to perform the TCLP, a 100-gram sample with a particle size of less than 9.5 mm was added to 2 liters of an extraction fluid consisting of 11.4 ml acetic acid in 2 liters of deionized water in an appropriate extraction vessel. This was placed on a rotation apparatus and tumbled, end over end, for eighteen hours. After tumbling, the liquid phase was separated from the solid phase by filtering the sample through a 0.7 µm glass-fiber filter. The resulting filtrate was then analyzed by atomic absorption.

Based on the results of these tests, a conclusion can be made to determine the quantity of cement needed to meet the objective.

3.0 RESULTS

3.1 Physical Description/Particle Size Distribution

The physical descriptions of the Harco samples are based on forty-pound specimens and are as follows:

Sample 1 consists of poorly graded medium sand with coarse and fine gravel. The content is approximately 70% medium sand and 30% subrounded coarse gravel, trace fine gravel and fine sand. It is moist and has a dark reddish brown color with reflective mica-like flecks that are soft and loosely packed.

Sample 2 consists of poorly graded fine sand with coarse gravel and medium sand. Approximately 95% is fine sand and 5% is subrounded coarse gravel. Sample 2 is wet and a yellowish red color with yellow and black clumps throughout. It is of medium stiffness and contains some roots and twigs.

Sample 3 consists of poorly graded medium sand with coarse gravel. The content is about 75% medium sand and 25% coarse gravel with trace subrounded coarse sand. Sample 3 is a reddish brown color, wet, very soft, and contains roots and twigs.

Sample 4 consists of poorly graded coarse sand-like material with angular coarse gravel. The content is about 85% coarse sand and 15% angular coarse gravel with trace fines. Interspersed with the coarse sand were small nodules of metallic material. These nodules were of the same approximate size as the sand grains. Sample 4 is a black color, firm, wet, with some roots and twigs. The angular coarse gravel seems to be a conglomerate of the coarse sand. This material has the physical appearance of electroplating sludge. The coarse material that had conglomerated into gravel-size nodules easily broke apart into the smaller sand-size particles in the seiving process. Therefore these nodules did not appear in the material retained on the 9.5 mm sieve. In the area of Sample 4 there is wood debris. This material was observed by the ERT representative on the site. The material appears to be portions of tree limbs and stumps ranging in size from 2 to 6 inches nominal diameter. The amount of this material in the area was not quantified but must be considered in evaluating treatment alternatives.

The results of the particle size analysis are presented in Table 1. The percent of samples less than 9.5 mm ranges from 70.3% to 94.1%.

3.2 XRF Analysis

Once grain size distribution had been determined, a sub sample of particle size less than 9.5 mm was selected from samples 1 through 4 and analyzed for metals using XRF. A summary of the results of lead and zinc appear in Table 2 and are summarized in Figure 4. The zinc concentrations ranged from 4,400 mg/kg at site 1 to 150,000 mg/kg at site 4. The lead concentrations ranged from 490 mg/kg at site 1 to 15,500 mg/kg at site 4. The other metals which were analyzed for are as follows: potassium, calcium, titanium, manganese, iron, nickel, copper, strontium, zirconium, chromium, rubidium, cadmium, tin, and barium (Appendix B, XRF Results).

3.4 Solidification/Stabilization

The load and deflection values for each test specimen were plotted to prepare stress-vs-strain graphs (Figures 5-8). The load at time of failure and deformation during loading were calculated and are presented in Table 4. The unconfined compressibility graphs show the stress-vs-strain curve comparing the same sample with different ratios of cement (Table 4, Figures 5-8). These data show the unconfined compressive strength ranging from 63.7 pounds per square inch (psi) to 1,540 psi. Two test specimens, 15% and 30% cement, for sample 4 did not develop enough strength to remain cohesive when the mold was removed. This represents a zero compressive strength and these samples were not tested.

Once the unconfined compressive strength tests had been performed, each failed sample, including the No. 4 samples with 15% and 30% cement, was crushed to a particle size of less than 9.5 mm, extracted using the TCLP, and subsequently analyzed for lead and zinc. The results of these analyses are presented in Table 5 and summarized in Figures 9 and 10. The zinc leachate concentration ranged from 0.03 to 152.0 mg/l. The lead leachate concentration ranged from 0.27 mg/l to 6.84 mg/l. The highest concentrations of lead and zinc occurred in sample 4.

3.5 Cleanup Goals

There are no U.S. EPA regulations or current guidelines for allowable levels or cleanup goals for zinc. Several states (New Jersey, California, and Washington) and foreign countries have established regulations controlling zinc concentrations in the soil. The literature indicates that zinc presents little or no hazard to human health but is toxic to many aquatic species when present in concentrations in excess of 0.1 mg/l. Table 6 presents a summary of zinc and lead cleanup criteria from state and foreign jurisdictions.

4.0 DISCUSSION OF RESULTS

The analytical data presented in this report is the result of screening analysis for metals in soil using x-ray fluorescence analyses and atomic absorption analysis for the TCLP extracts.

4.1 Physical Description/Particle Size Analysis

The physical appearance of soils, representing the different locations on the site, indicates that three different types of soil were collected. Sample No. 1 and 3, similar soils, are probably representative of a soil type indigenous to the area. Sample No. 2 has the physical characteristics of water-borne sediment and fines indicative of outwash areas of soil erosion. Sample No. 4 is not a naturally occurring material and has the characteristics of plating sludges. Nodules of this material broke apart easily and could not be separated by sieving (i.e. passed through the sieves with the remaining material). The wood fragments found in the soil in the area of sample collection point 4 are present in sufficient quantity that this material must be addressed in a waste minimization step prior to treatment of the soil.

The particle size analysis indicates that the portion of the samples that are less than 9.5 mm ranges from 70% to 94%. The smallest screen size that can practically be used to separate gravel from soil is 9.5 mm. The fine material in samples 3 and 4 made wet screening with sieve sizes less than 9.5 mm virtually impossible due to clogging. The relatively small percentage of material retained on the 9.5 mm screen indicates that the gravel on-site is too small to be screened out of the contaminated soil. The nodules of metallic material interspersed with the coarse sand could not be separated from the sand by sieving. This determination resulted in focusing on solidification for the remediation of the contaminated soil.

4.2 XRF Analysis

The XRF analytical results show an apparent correlation between the zinc and lead concentrations in the soil samples. The lead concentration is between 10 % and 15 % of the zinc concentration in the four soil samples. The lead concentration ranged from 400 mg/kg to 15,000 mg/kg, while the zinc concentrations ranged from 4,400 mg/kg to 150,000 mg/kg. The metal concentrations present indicate that all areas sampled were contaminated to some extent by the plating sludges.

4.3 Solidification/Stabilization

The solidification results are evaluated on the basis of two criteria: 1) unconfined compressive strength, and 2) TCLP metals concentration. Guidance documents (USEPA OWSER Directive, No. 9437.00-2A) recommend that solidified materials demonstrate an unconfined

compressive strength of 50 psi for landfill disposal. Regulations require that the TCLP lead concentration not exceed 5.0 ppm (40 CFR 261.24). There is no regulatory requirement for TCLP zinc concentrations.

The soil represented by samples 1, 2, and 3 exhibited an unconfined compressibility strength in excess of 50 psi with 15 %, 30 %, and 45 % cement addition. Sample 4 required 45 % cement in order to exceed the 50 psi requirement. At 15 % and 30 % cement addition, sample 4 did not develop sufficient strength to be set up in the testing apparatus.

The TCLP lead results for samples 1, 2, and 3 ranged from 0.27 to 0.30 ppm with 15 %, 30 %, and 45 % cement addition. A mixture of 15 % cement is adequate to achieve the regulatory requirement specifying that the TCLP lead concentration be equal to or less than 5.0 mg/l. Sample 4 exceeded the 5.0 ppm lead standard with the 15 % cement mixture at a concentration of 6.84 ppm. The TCLP results for the 30 % and 45 % mixtures were 0.33 and 0.34 ppm.

4.4 Cleanup Goals

The published cleanup targets for zinc range from 220 to 1500 mg/kg. The acceptable soil level in the state of New Jersey is 350 mg/kg. The likelihood of migration of zinc into surface waters is highly dependent on the compounds of zinc, the acidity of the groundwater and runoff, and the permeability of the soil. Typical zinc salts ($ZnSO_4$, $ZnCl_2$) are more soluble than the corresponding lead salts. This information, in conjunction with the fact that the zinc concentrations in the soil are ten times higher than the lead concentration, indicates that the cleanup goal for zinc will probably be the controlling factor in the removal action. A practical zinc target for soil remaining in place after excavation of the highly contaminated material at the Harco Site can be based on targets that have been used in California (250 mg/kg) and New Jersey (350 mg/kg).

5.0 CONCLUSIONS

The wood debris should be separated from the contaminated soil in the area of sample 4. This can be achieved by either screening or flotation. The choice of the waste minimization technique (for the wood) will be dependent upon the selection of remedies for the contaminated soil.

There is not enough gravel or solid material larger than 9.5 mm mixed with the contaminated soil to warrant separation of the gravel from the soil and washing the contaminated material from the gravel.

A mixture of 15 % cement and soil is adequate to achieve a compressive strength of 50 psi and to adequately encapsulate the lead and zinc in the soils represented by samples 1, 2, and 3. The material in sample 4 requires a cement mixture in excess of 30 % to achieve an adequate compressive strength. The 30 % mix is adequate to encapsulate the lead and zinc. From this data, it can be concluded that it would be cost effective to establish different staging piles of the site material in order that the most economical mix of solidification agents can be used.

A cleanup target of 250 mg/kg zinc for the site soil will also meet the guideline recommendations for lead. This is a conservative recommendation and is influenced by the fact that there may be aquatic resources on or near the site.

Any action taken to remove the contaminated material from the site or to solidify the soil on-site will require the upgrading of the access road to the site to accomodate heavy trucks and construction equipment.

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U.S. Environmental Protection Agency, OSWER Directive 9355.4-02A (January 1990), *Supplement to Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.*

Wilton, CT Department of Environmental Health, Memorandum to Wilton, CT Planning and Zoning Commission, RE: G & D Construction - Harco Property Subdivision, January 20, 1986.

New Jersey Department of Environmental Protection, 1988, Memorandum on Action Levels for Soils and Sediments, Division of Hazardous Site Mitigation, Trenton, NJ.

Tables

TABLE 1
PERCENT GRAVEL BASED ON DRY SAMPLE
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

SAMPLE	TOTAL WEIGHT (grams)	<9.5mm (grams)	% OF TOTAL	>9.5mm and <16mm (grams)	% OF TOTAL	> 16mm (grams)	% OF TOTAL
#1	942.80	663.19	70.3	16.25	1.72	263.36	27.9
#2	929.57	875.10	94.1	20.02	2.15	34.45	3.70
#3	848.71	646.83	76.2	18.65	2.20	183.23	21.6
#4	712.59	599.83	84.2	10.66	1.50	102.10	14.3

TABLE 2
LEAD AND ZINC RESULTS BY XRF OF DRIED UNSOLIDIFIED
SAMPLE PARTICLE SIZE OF LESS THAN 9.5 mm
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

SAMPLE #	ZINC (mg/kg)	LEAD (mg/kg)
1	4,500	490
2	14,500	2,000
3	15,000	2,500
4	152,000	15,500

TABLE 3
SOLIDIFICATION ADDITIVIES
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

SAMPLE NUMBER	SAMPLE WEIGHT WET	WEIGHT OF CEMENT IN GRAMS	WATER ADDED IN ML	CEMENT PERCENT
1	600	90	30	15
1	600	180	46	30
1	600	270	86	45
2	660	99	0	15
2	670	201	0	30
2	679	305	0	45
3	702	105	0	15
3	700	210	0	30
3	699	315	0	45
4	600	90	0	15
4	600	180	0	30
4	600	270	0	45

TABLE 4
UNCONFINED COMPRESSIVE STRENGTH
SOLIDIFICATION RESULTS STUDY
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

SOLIDIFIED SAMPLE NUMBER	PERCENT CEMENT	LOAD AT FAILURE (in pounds)	COMPRESSIVE STRENGTH (LB per square in)
1	15	1780	560
1	30	1960	610
1	45	4830	1540
2	15	260	82.8
2	30	650	210
2	45	2600	830
3	15	200	63.7
3	30	2270	720
3	45	1900	600
4	15	NOT RUN	N/A
4	30	NOT RUN	N/A
4	45	360	110

TABLE 5
CONCENTRATION OF METALS IN TCLP* LEACHATE FROM HARCO SOLIDIFICATION STUDY
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

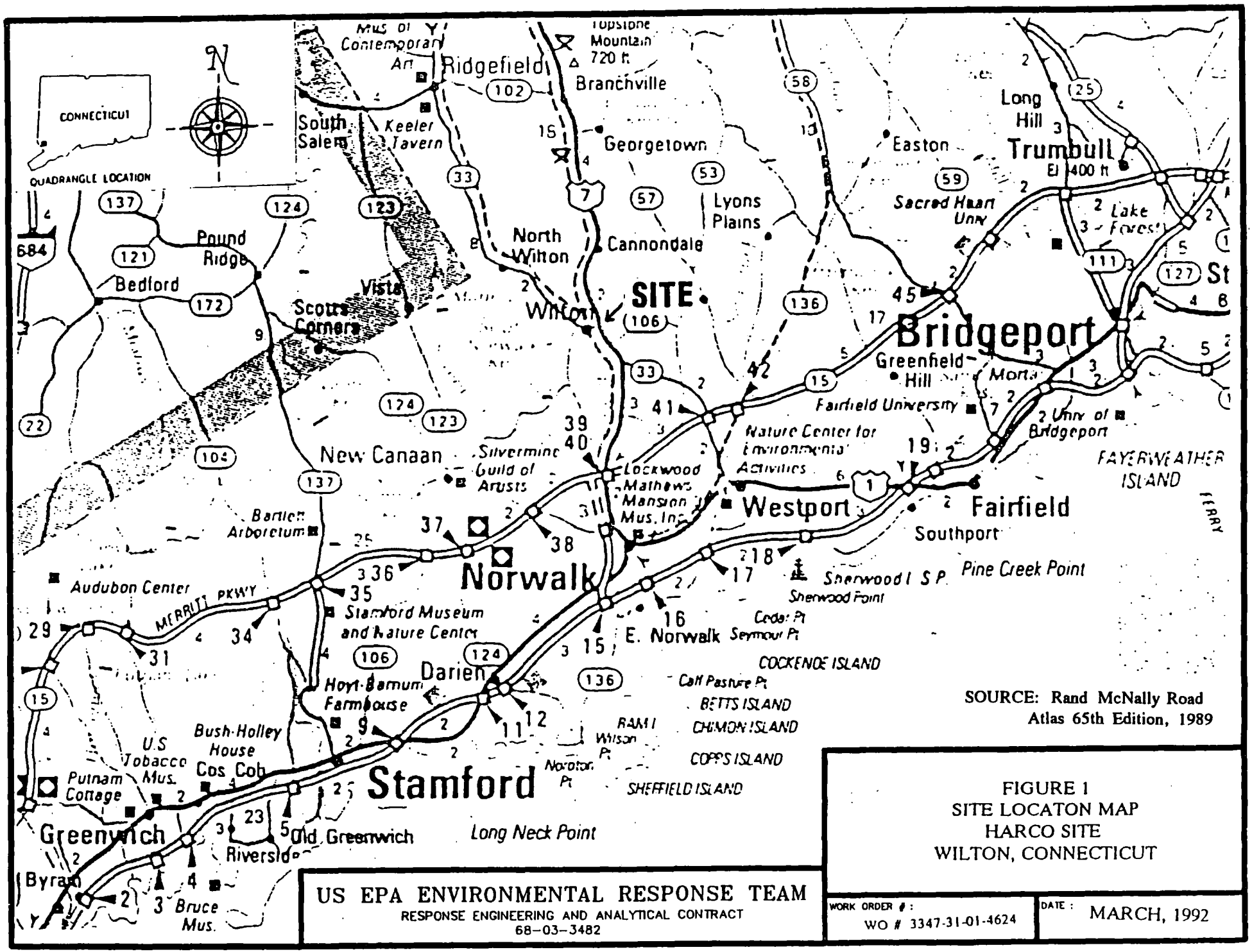
SAMPLE #	% CEMENT	% SOLIDS	FINAL pH (filtrate)	TCLP Zinc (mg/l)	TCLP Lead (mg/l)
1	15	82.6	6.72	11.0	0.27
1	30	82.6	10.47	0.04	0.30
1	45	82.6	10.89	0.06	0.30
2	15	55.4	7.96	1.17	0.29
2	30	55.4	10.79	0.03	0.29
2	45	55.4	11.20	0.03	0.32
3	15	61.6	8.24	0.36	0.28
3	30	61.6	10.73	0.03	0.29
3	45	61.6	11.26	0.05	0.29
4	15	57.0	7.29	152.0	6.84
4	30	57.0	10.96	0.06	0.33
4	45	57.0	11.33	0.04	0.34
Extraction fluid blank	N/A	N/A	N/A	0.05	<0.05

*TCLP - Toxicity Characteristic Leaching Procedure

TABLE 6
COMPARISON OF SOIL CLEANUP CRITERIA FOR LEAD AND ZINC
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

REFERENCE	DESCRIPTION	ZINC	LEAD
ALBERTA	Acidic Soils (pH < 6.5)	700	800
ONTARIO	Residential/Agricultural Commercial/Parkland Industrial	220 800 800	60 500 1000
QUEBEC	Background Investigation Cleanup	100 500 1500	50 200 600
ENGLAND	Domestic Gardens/Allotments Parks/Open Fields Industrial	300 -- --	500 2000 --
NETHERLANDS	Background Moderate Contamination Severe Contamination	200 500 3000	50 150 600
WEST GERMANY	Normal Tolerable	3 - 50 300	0.1 - 20 100
NEW JERSEY	Acceptable Soil Level	350	250 - 1000
CALIFORNIA	Soluble Threshold Limit Total Threshold Hazardous	250 5000	5 1000
WASHINGTON		Background soil level, or 10 X background water quality, or 10 X Drinking water standard	

Figures

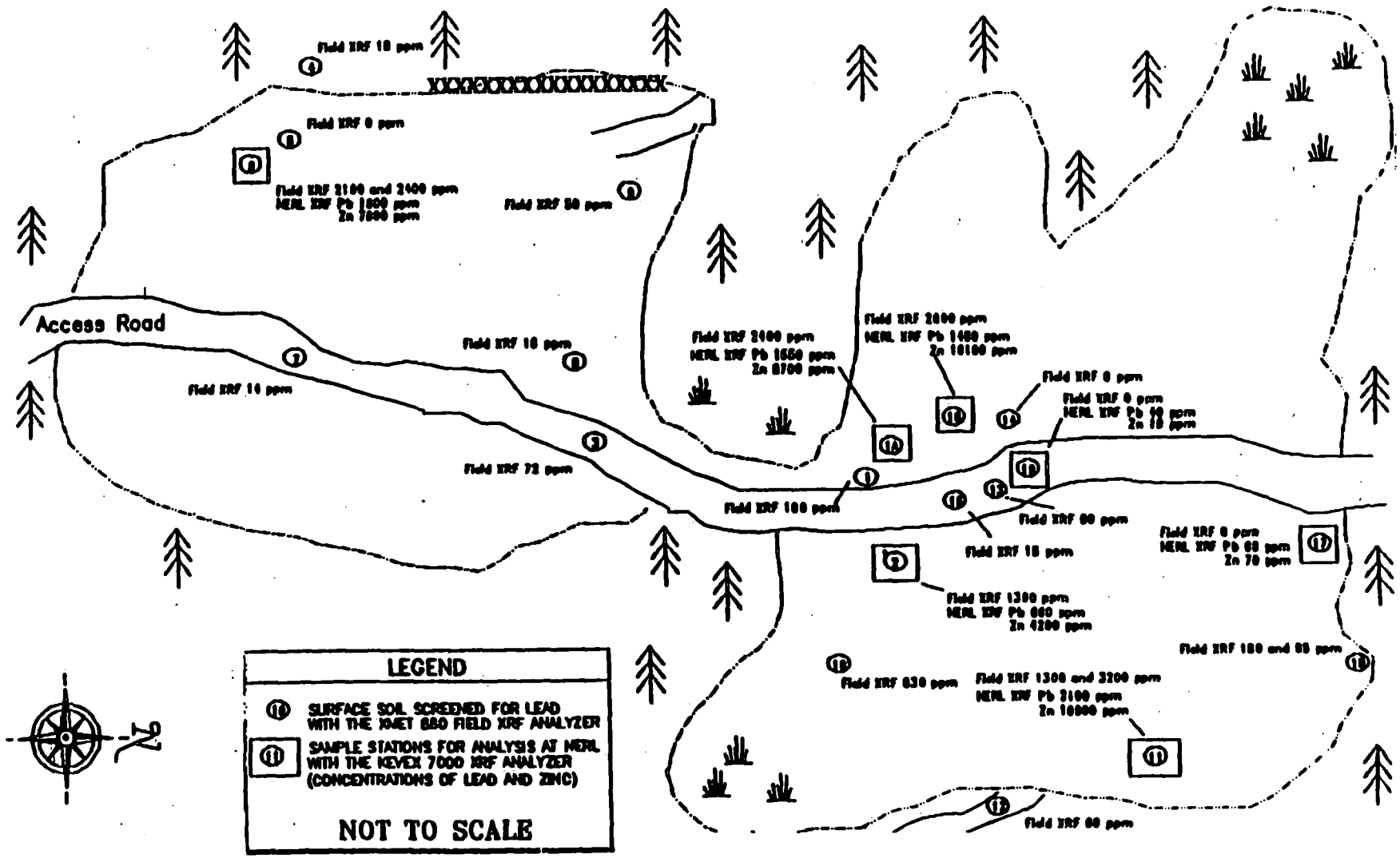


US EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-03-3482

FIGURE 1
SITE LOCATON MAP
HARCO SITE
WILTON, CONNECTICUT

WORK ORDER # :
WO # 3347-31-01-4624

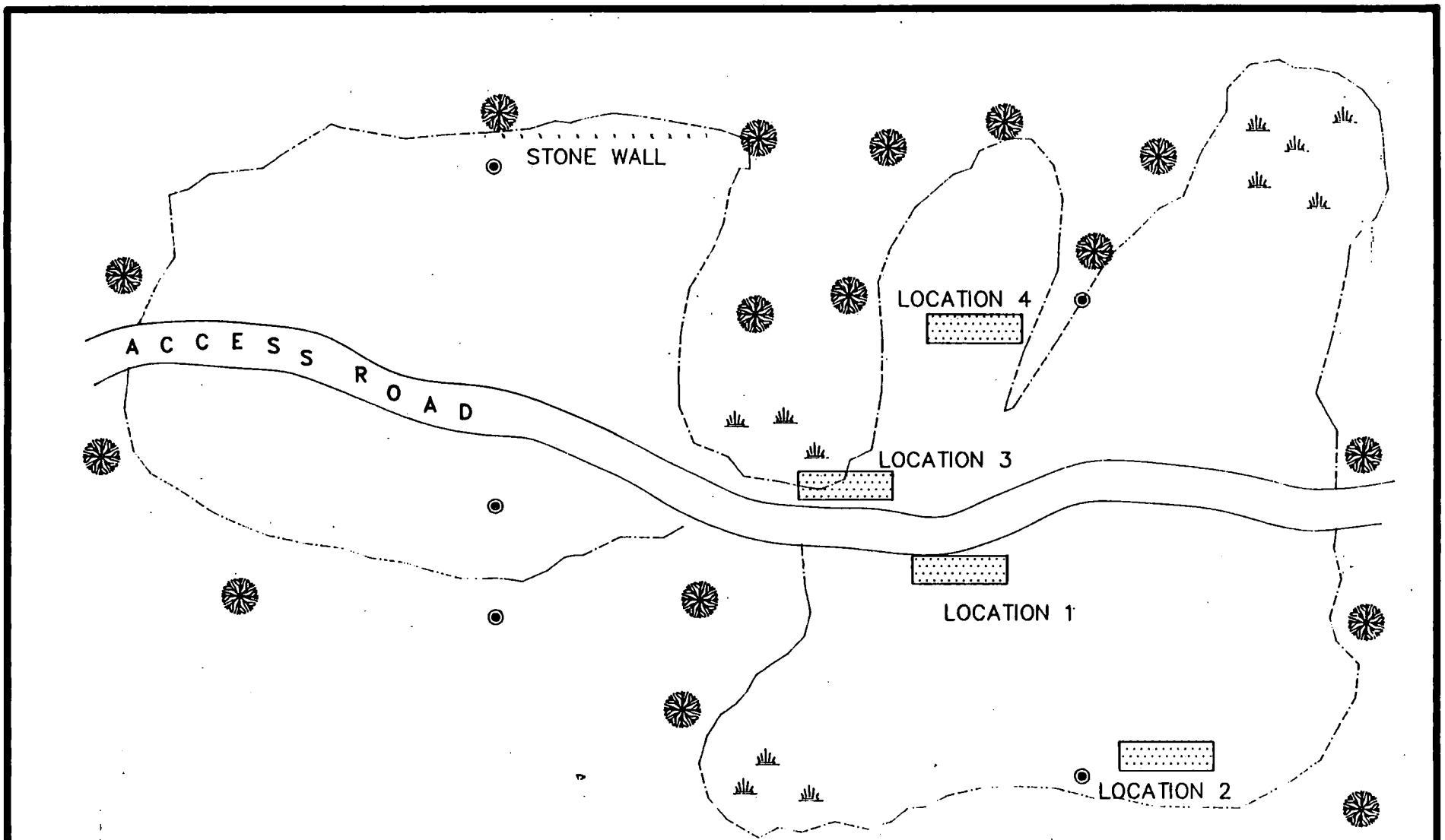
DATE : MARCH, 1992



source: U.S. EPA Preliminary Assessment /Site Investigation
Harco Property Site, September 25, 1992

US EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-03-3482 WO # 3347-31-01-4624

FIGURE 2
SITE DIAGRAM
HARCO SITE
WILTON, CONNECTICUT
MARCH, 1992



LEGEND

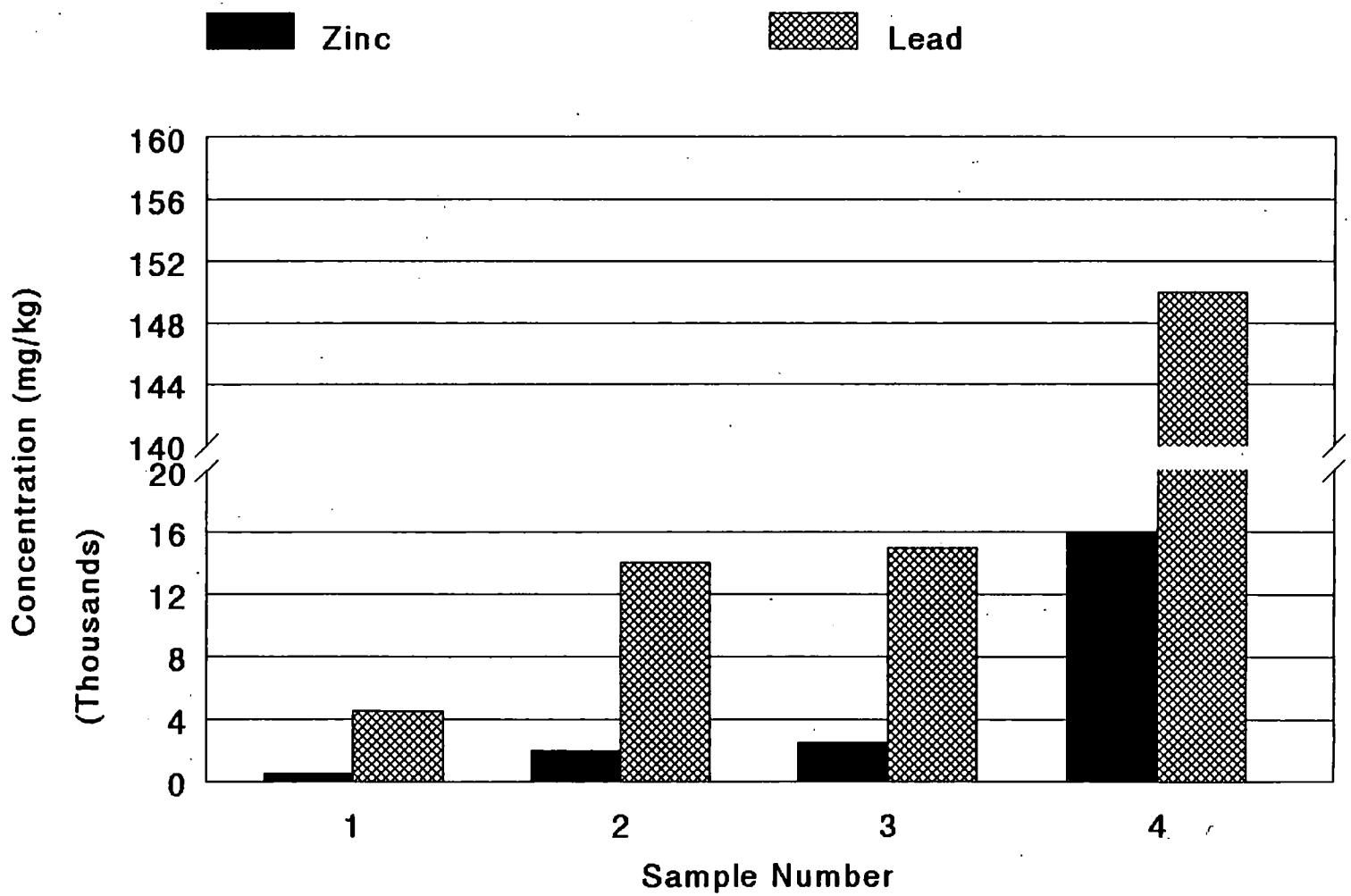
- SURVEY CONTROL POINTS
- CONTAMINATED BOUNDARY
- SAMPLING AREA DESIGNATIONS

NOT TO SCALE

US EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-03-3482
W.O. 3347-31-01-4624

FIGURE 3
SAMPLE LOCATIONS
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

XRF Results



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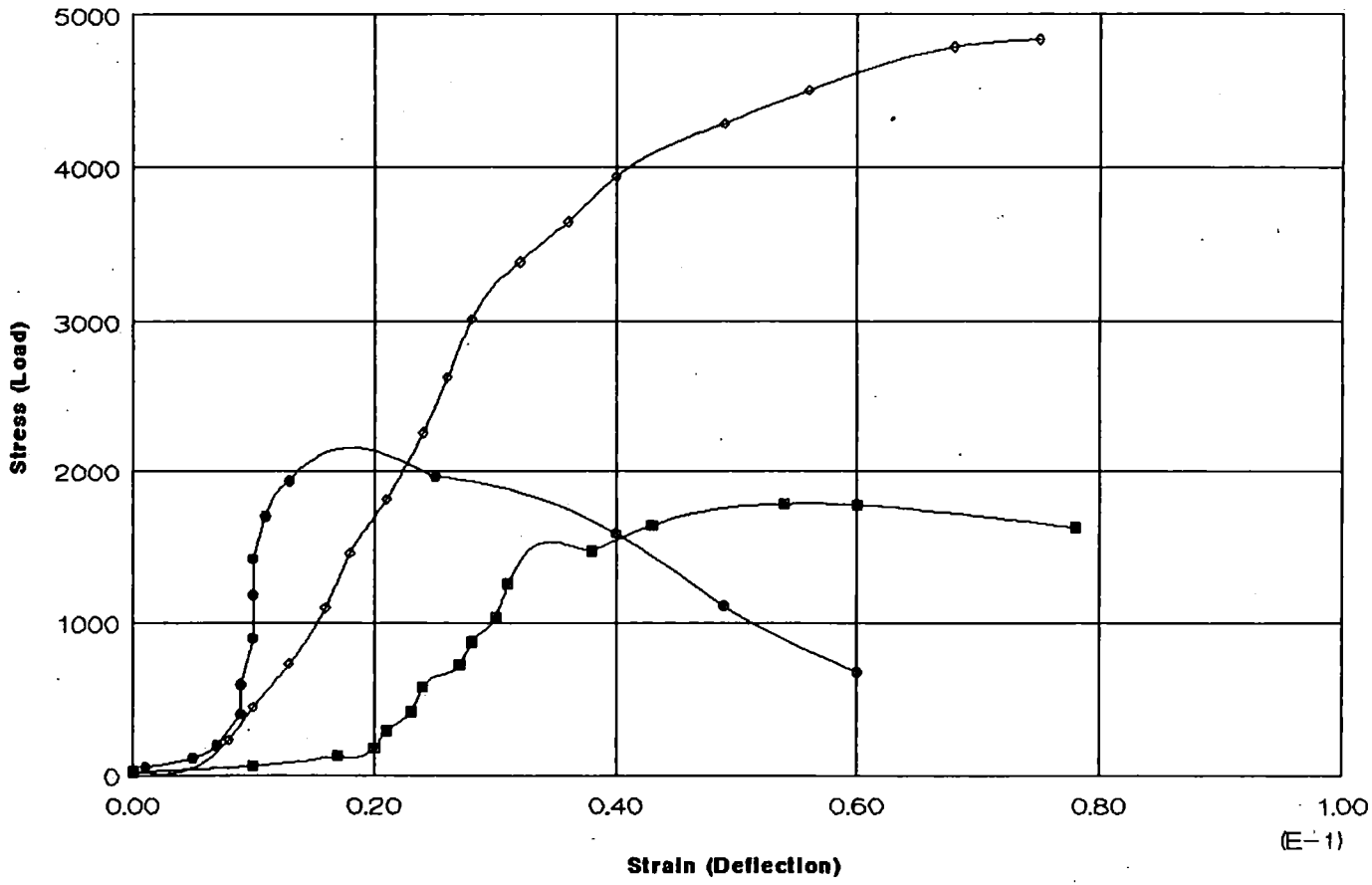
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
WO# 3347-31-01-4624
68-03-3482

FIGURE 4
HARCO SITE
WILTON, CONNECTICUT
APRIL, 1992

Unconfined Compressibility

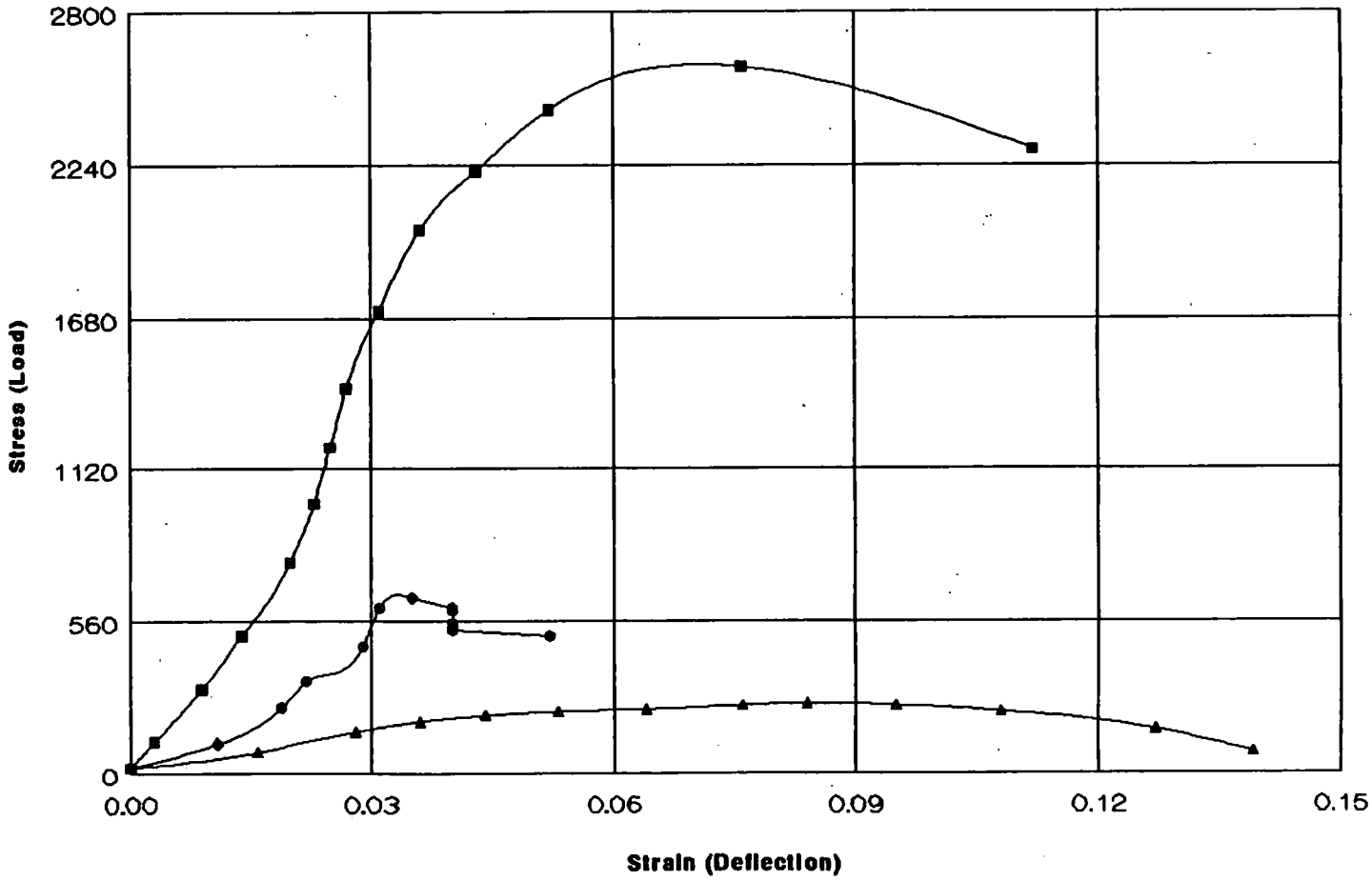
Soil Sample #1



US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4624 68-03-3482	FIGURE 5 HARCO SITE WILTON, CONNECTICUT April, 1992

Unconfined Compressibility

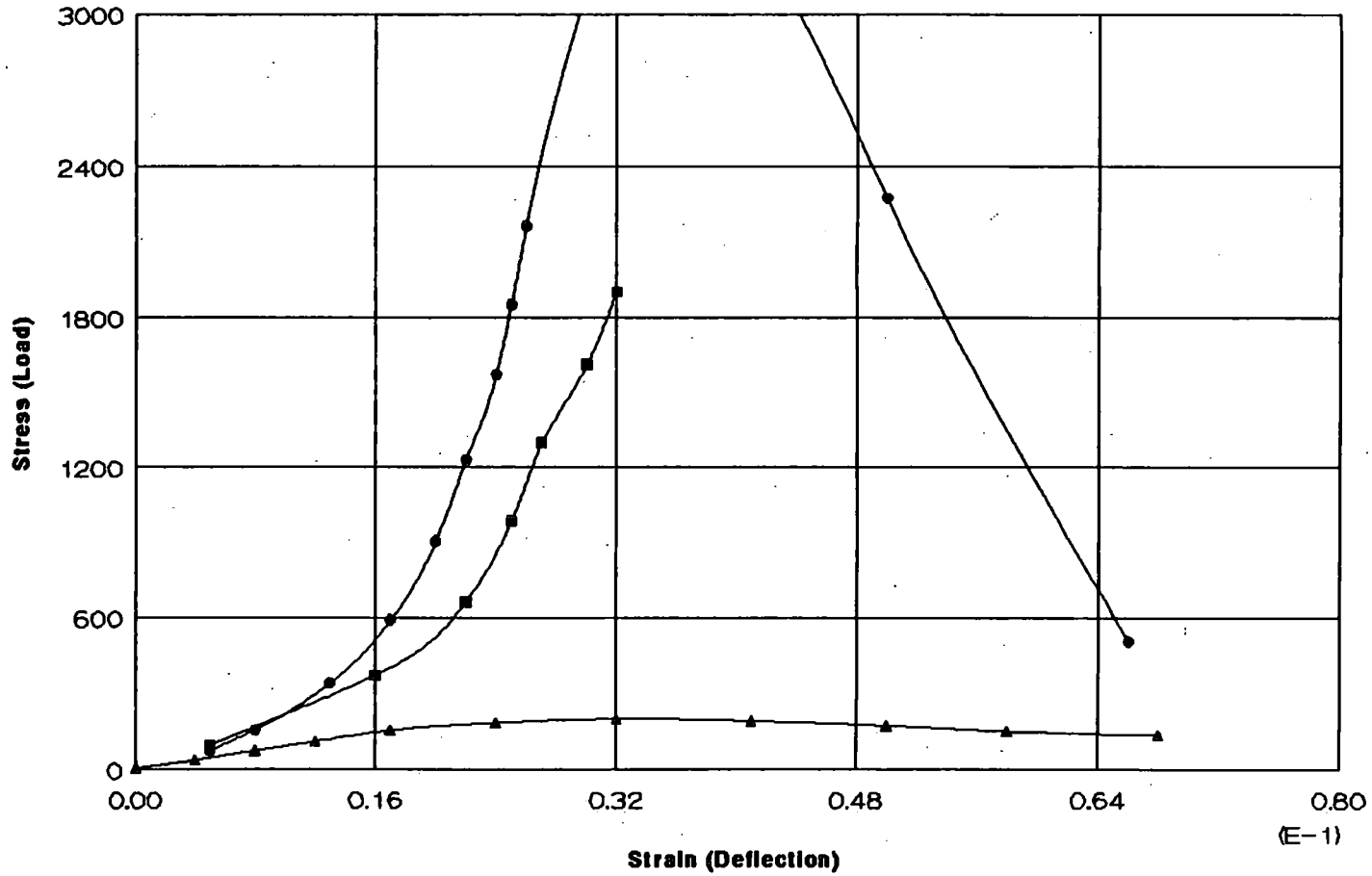
Soil Sample #2



US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4583 68-03-3482	FIGURE 6 HARCO SITE WILTON, CONNECTICUT APRIL, 1992

Unconfined Compressibility

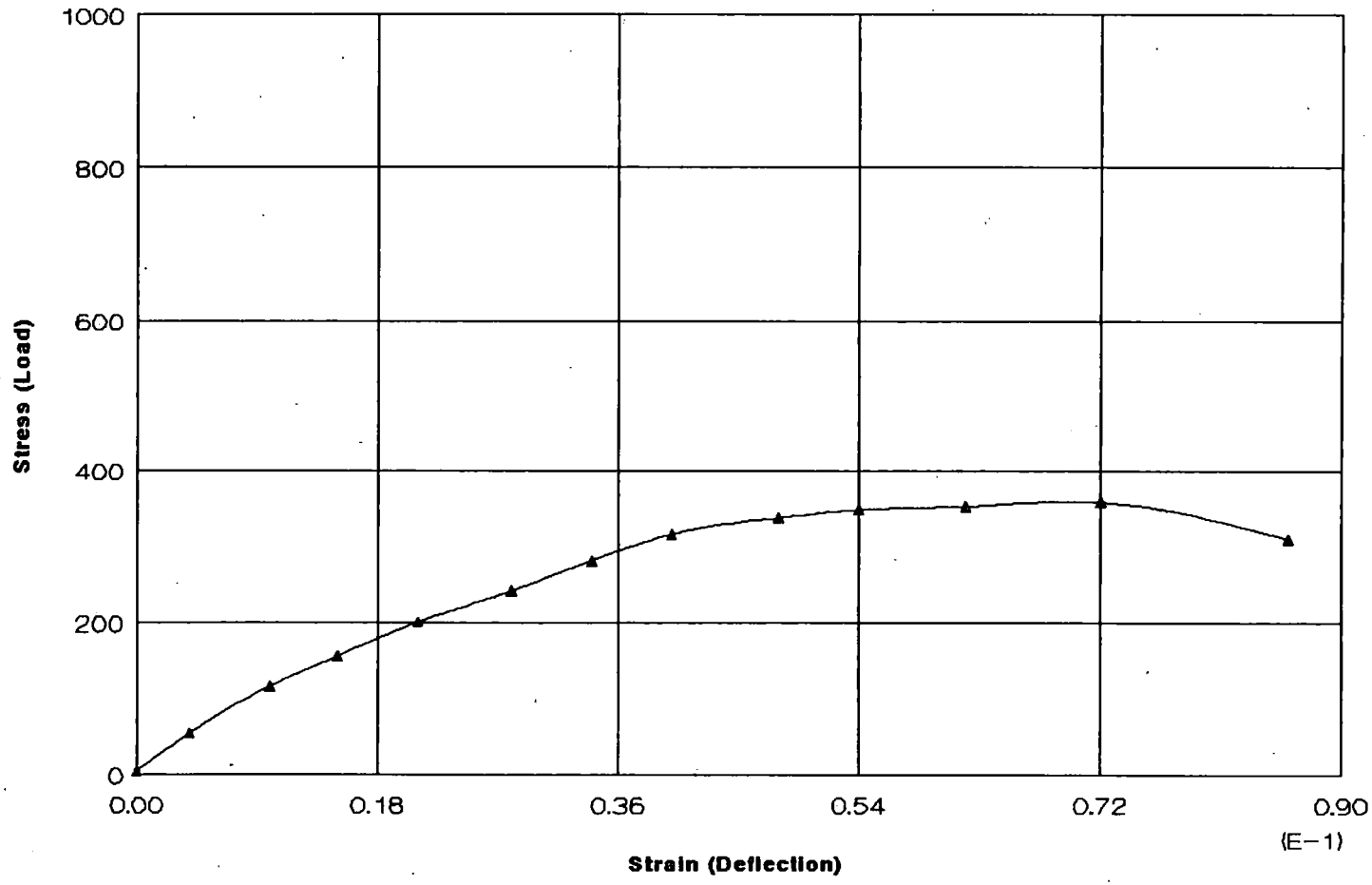
Soil Sample #3



US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4624 68-03-3482		FIGURE 7 HARCO SITE WILTON, CONNECTICUT APRIL, 1992

Unconfined Compressibility

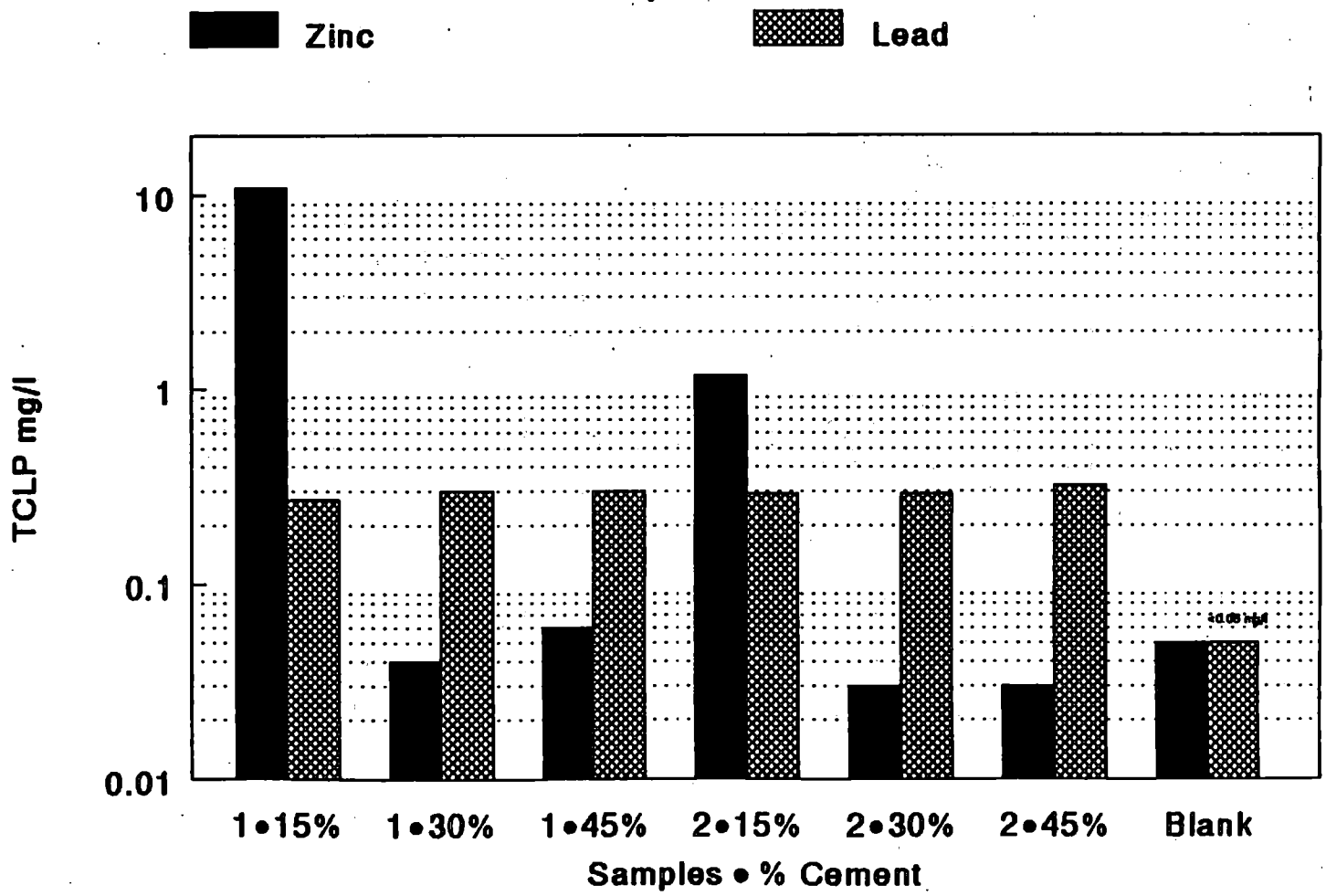
Soil Sample #4



▲ 45% Cement

US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4583 68-03-3482	FIGURE 8 HARCO SITE WILTON, CONNECTICUT APRIL, 1992

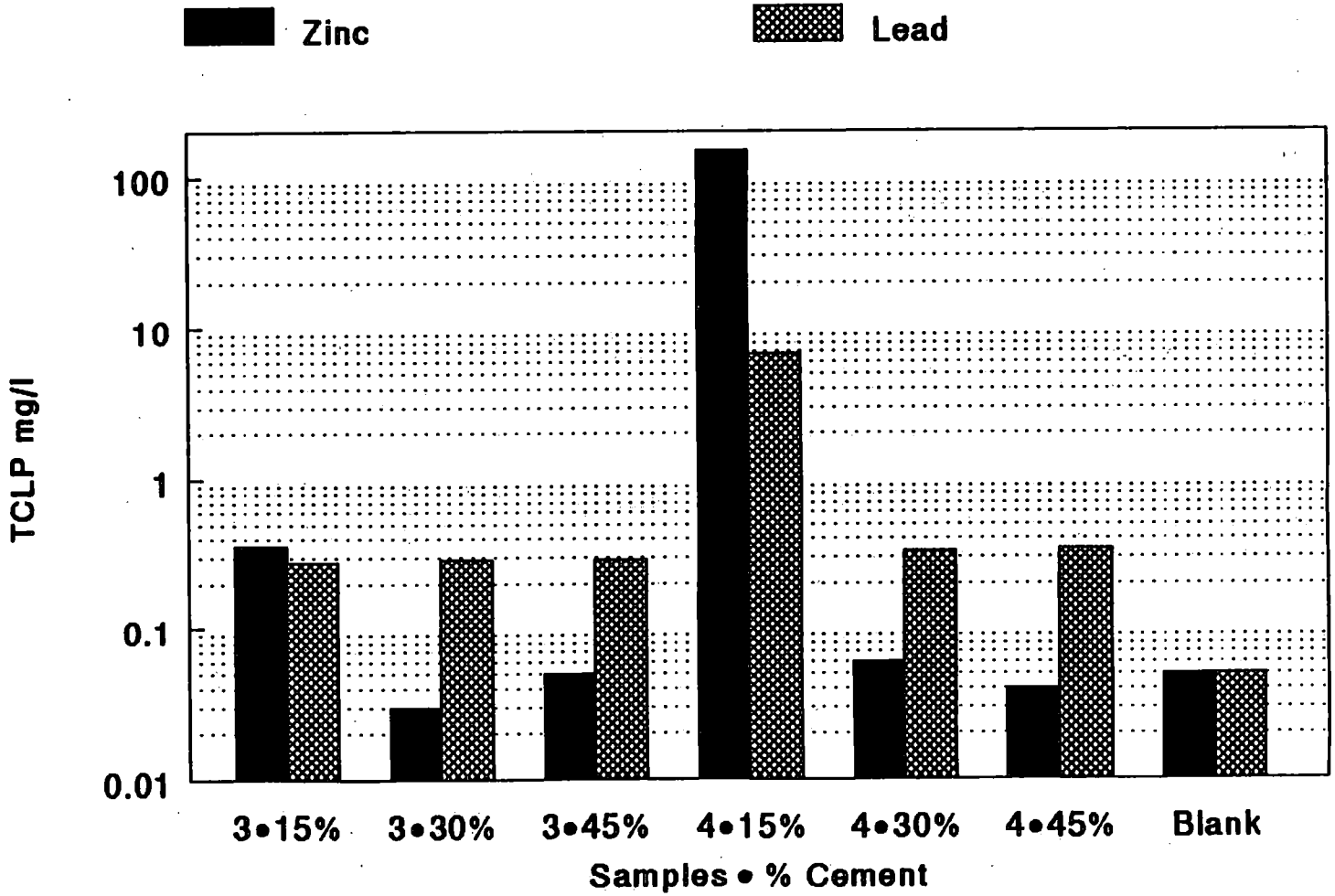
TCLP Results
Samples #1 & #2



US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4624 68-03-3482	FIGURE 9 HARCO SITE WILTON, CONNECTICUT APRIL, 1992

TCLP Results

Samples #3 & #4



US EPA ENVIRONMENTAL RESPONSE TEAM RESPONSE ENGINEERING AND ANALYTICAL CONTRACT WO# 3347-31-01-4624 68-03-3482	FIGURE 10 HARCO SITE WILTON, CONNECTICUT APRIL, 1992

Appendix A

Appendix A
Field Data Sheets
Harco Site
Wilton, Connecticut
May, 1992

Roy F. Weston, Inc.
REAC, Edison, N.J.
EPA Contract 68-03-3482

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

No: 6905

SHEET NO. 1 OF 1

Project Name: HARCO PROPERTY SITE, CT.
Project Number: 3347-31-01-4624
RFW Contact: DAN FITZGERALD Phone:

SAMPLE IDENTIFICATION

ANALYSES REQUESTED

REAC #	Sample No.	Sampling Location	Matrix	Date Collected	# of Bottles	Container/ Preservative	Treatab: 1 day*			
	15120	SAMPLE LOC. #1	S	3.31.92	1	5 GALL, Bucket	X			
	15121	SAMPLE LOC #2	S	3.31.92	1	5 Gal Bucket	X			
	15122	SAMPLE LOC #3	S	3.31.92	1	5 Gal Bucket	X			
	15075	SAMPLE LOC #4	S	3.31.92	1	5 Gal Bucket	X			

Matrix:
SD - Sediment
DS - Drum Solids
DL - Drum Liquids
X - Other
PW - Potable Water
GW - Groundwater
SW - Surface Water
SL - Sludge
S - Soil
W - Water
O - Oil
A - Air

Special Instructions:
*For use in REAC Treatability Lab

FOR SUBCONTRACTING USE ONLY
FROM CHAIN OF
CUSTODY #

Items/Reason	Relinquished By	Date	Received By	Date	Time	Items/Reason	Relinquished By	Date	Received By	Date	Time
All Samples	[signature]	3/31/92	D. Fitzgerald	4/1/92							

FIELD DATA SHEET

15075

Roy F. Weston, Inc.
REAC, Edison, N.J.
EPA Contract 68-03-3482

Date: 3.31.92
Time: 1525
Samplers: R. Nadeau / G. Buchanan
Site Name: Hurco Site
Sample Location SAMPLE # 4
Chain of Custody No. 6905
REAC Task Leader: FitzGerald
EPA WAM Nadeau
Work Assignment No.: 3749-31-01-4624

SITE DESCRIPTION
landfill, industrial, commercial, residential, hedgerows; old field, wooded, farmland, gully, floodplain; upland palustrine, lowland riverine, lacustrine

SOIL TYPE
rock, gravel, sand, silt; clay, muck, loam, peat
color brown to Black

SURFACE WATER
color ____ odor ____ flow ____ direction ____

STREAM
width ____ depth ____ velocity ____ cm/s pools ____ % riffles ____ %

BOTTOM
rock, rubble, gravel, shell, sand; silt, clay, organic, other ____

SAMPLE TYPE
surface water, groundwater, potable water, sediment, soil; effluent, sludge, leachate, waste, other ____

DEVICE
kemmerer, ponar, trowel, other Shovel, bucket, auger, ekman

SAMPLE INFORMATION
color ____ pH ____ odor ____ ORP ____ temp ____ salinity ____ DO ____ sample depth ____ cond ____ tide stage ____

WEATHER PARAMETERS
ambient temp ____ barometric pressure See relative humidity ____ weather conditions Breezy

ANALYSES TO BE PERFORMED

ORGANICS
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ____

INORGANICS
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ____

RCRA
A. TCLP
B. ignitability
C. corrosivity ____ pH ____
D. reactivity
E. other ____

OTHER ANALYSIS
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. Grain Size
L. other ____
M. other ____

SAMPLE PREPARATION

CONTAINER
glass jar, plastic jar, acetate core, plastic bag, plastic bucket, other ____

PRESERVATIVES
HNO_3, NaOH, Zn Acetate, HCl, Na_2SO_4, other ____

STORAGE
wet ice, dry ice, ambient

COMMENTS:

Northern side of site, Flag 3+50, 100N approx. 25' to the east
Water to the surface of the hole
Depth of hole 18-24"
Soil color Black / Dark brown with aggregates (from process?)

FIELD DATA SHEET

15122

Roy F. Weston, Inc.
REAC, Edison, N.J.
EPA Contract 68-03-3482

Date: 3.31.92
Time: 1510
Samplers: R. Nadeau / C. Buchanan
Site Name: HARCO PROPERTY
Sample Location: SAMPLE LOCATION #3
Chain of Custody No. 6905
REAC Task Leader: Fitzgerald
EPA WAM: Nadeau
Work Assignment No.: 3347-3101-4624

SITE DESCRIPTION			SOIL TYPE		SURFACE WATER	STREAM	BOTTOM	
(landfill)	old field	upland palustrine	rock	clay	color	width	rock	silt
industrial	wooded	lowland riverine	gravel	muck	odor	depth	rubble	clay
commercial	farmland	lacustrine	sand	loam	flow	velocity cm/s	gravel	organic
residential	gully		silt	peat	direction	pools %	shell	other
hedgerows	floodplain		color dark to reddish brown			riffles %	sand	

SAMPLE TYPE		DEVICE		SAMPLE INFORMATION		WEATHER PARAMETERS
surface water	effluent	kemmerer	ponar	color	pH	ambient temp
groundwater	sludge	trowel	other shovel	odor	ORP	barometric pressure
potable water	leachate	bucket		temp	salinity	relative humidity
sediment	waste	auger		DO	sample depth	weather conditions
(soil)	other	ekman		cond	tide stage	

ANALYSES TO BE PERFORMED

ORGANICS
- A. halogenated & aromatic volatiles
- B. volatiles
- C. trihalomethanes
- D. pesticides/PCB
- E. PCB
- F. base neutral/acid extractables
- G. pesticides, drinking water
- H. herbicides, drinking water
- I. other

INORGANICS
- A. metals, priority pollutant
- B. metals, TAL
- C. metals scan (ICP)
- D. metals, other

RCRA
- A. TCLP
- B. ignitability
- C. corrosivity ____ pH ____
- D. reactivity
- E. other

OTHER ANALYSIS
- A. total cyanide
- B. total phenol
- C. petroleum hydrocarbons
- D. pH
- E. alkalinity
- F. hardness
- G. total dissolved solids
- H. total suspended solids
- I. sulfate
- J. TOC
- K. Grain Size
- L. other
- M. other

SAMPLE PREPARATION

CONTAINER	PRESERVATIVES
glass jar	HNO_3
plastic jar	NaOH
acetate core	Zn Acetate
plastic bag	HCl
(plastic bucket)	Na_2SO_4
other	other

STORAGE
- wet ice
- dry ice
- ambient

COMMENTS:

At Flag 3+00, 50N adjacent to wetland
Hole ≈ 1½' deep
≈ 20' north of road
Soil very moist - dark to reddish brown
fewer stones
Water at 12-14"

FIELD DATA SHEET

15121

Roy F. Weston, Inc.
REAC, Edison, N.J.
EPA Contract 68-03-3482

Chain of Custody No. 6905

Samplers: R. Nadeau / G. Buchanan

REAC Task Leader: Fitz Gerald

Date: 3.31.92

Site Name: HARCO PROPERTY

EPA WAM Nadeau

Time: 1505

Sample Location LOCATION # 2

Work Assignment No.: 3347-31-01-4G24

SITE DESCRIPTION			SOIL TYPE		SURFACE WATER	STREAM	BOTTOM	
landfill	old field	upland palustrine	rock	clay	color	width	rock	silt
industrial	wooded	lowland riverine	gravel	muck	odor	depth	rubble	clay
commercial	farmland	lacustrine	sand	loam	flow	velocity cm/s	gravel	organic
residential	gully		silt	peat	direction	pools %	shell	other
hedgerows	floodplain		shale? color Red			riffles %	sand	

SAMPLE TYPE		DEVICE		SAMPLE INFORMATION		WEATHER PARAMETERS	
surface water	effluent	kemmerer	ponar	color	pH	ambient temp	
groundwater	sludge	trowel	other Shovel	odor	ORP	barometric pressure	See
potable water	leachate	bucket		temp	salinity	relative humidity	
sediment	waste	auger		DO	sample depth	weather conditions	Pleasant
soil	other	ekman		cond	tide stage		

ANALYSES TO BE PERFORMED

ORGANICS
- A. halogenated & aromatic volatiles
- B. volatiles
- C. trihalomethanes
- D. pesticides/PCB
- E. PCB
- F. base neutral/acid extractables
- G. pesticides, drinking water
- H. herbicides, drinking water
- I. other

INORGANICS
- A. metals, priority pollutant
- B. metals, TAL
- C. metals scan (ICP)
- D. metals, other

RCRA
- A. TCLP
- B. ignitability
- C. corrosivity ____ pH ____
- D. reactivity
- E. other

OTHER ANALYSIS
- A. total cyanide
- B. total phenol
- C. petroleum hydrocarbons
- D. pH
- E. alkalinity
- F. hardness
- G. total dissolved solids
- H. total suspended solids
- I. sulfate
- J. TOC
- K. Grain Size
- L. other
- M. other

SAMPLE PREPARATION

CONTAINER	PRESERVATIVES
glass jar	HNO_3
plastic jar	NaOH
acetate core	Zn Acetate
plastic bag	HCl
plastic bucket	Na_2SO_4
other	other

STORAGE
- wet ice
- dry ice
- ambient

COMMENTS:

Near Flag 3+50, SOS (10 meters from flag)
by rock outcrop

Rock (bedrock?) at ≈ 10-12"

FIELD DATA SHEET

15120

Roy F. Weston, Inc.
REAC, Edison, N.J.
EPA Contract 68-03-3482

Date: 3/31/92
Time: 1500
Samplers: R. Wadean / G. Buchanan
Site Name: HARCO PROPERTY
Sample Location: SAMPLE LOCATION # 1
Chain of Custody No. 6905
REAC Task Leader: FitzGerald
EPA WAM: Wadean
Work Assignment No.: 3347-31-01-4624

SITE DESCRIPTION
(landfill) industrial commercial residential hedgerows
old field wooded farmland gully floodplain
upland palustrine lowland riverine lacustrine

SOIL TYPE
rock gravel (sand) silt
clay muck loam peat
color Dark Brown

SURFACE WATER
color ____ odor ____ flow ____ direction ____

STREAM
width ____ depth ____ velocity ____ cm/s pools ____ % riffles ____ %

BOTTOM
rock rubble gravel shell sand
silt clay organic other ____

SAMPLE TYPE
surface water groundwater potable water ~~sediment~~ (soil)
effluent sludge leachate waste other ____

DEVICE
kemmerer trowel bucket auger ekman
ponar other SHOVEL

SAMPLE INFORMATION
color ____ odor ____ temp ____ DO ____ cond ____
pH ____ ORP ____ salinity ____ sample depth ____ tide stage ____

WEATHER PARAMETERS
ambient temp ≈50 °F
barometric pressure ____
relative humidity ____
weather conditions Partly Sunny

ANALYSES TO BE PERFORMED

ORGANICS
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ____

INORGANICS
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ____

RCRA
A. TCLP
B. ignitability
C. corrosivity ____ pH ____
D. reactivity
E. other ____

OTHER ANALYSIS
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. Grain Size
L. other ____
M. other ____

SAMPLE PREPARATION

CONTAINER
glass jar
plastic jar
acetate core
plastic bag
(plastic bucket)
other ____

PRESERVATIVES
HNO_3
NaOH
Zn Acetate
HCl
Na_2SO_4
other ____

STORAGE
wet ice
dry ice
ambient

COMMENTS:

Near Flag # 3+00
Total depth ≈ 1 Inch
Rocks + pebbles in soil
Site along side of road
South side of site
Soil is wet

Filled bucket ≈ 3/4 full

This book is designated for the HARCO site.
The assignment # is 4624.
4 Buckets are delivered from the Cooler To the Engg Evaluation lab. All 4 buckets are 5-gal size.

Sample #	Matrix	Date Collected
15120	S	8/31/92
15121	S	↓
15122	S	
15123	S	
~~15124~~	~~S~~	

Pictures are analyzed from HARCO site. The following observations are made

- The site is a wetland area.
- Rivers & Trees are indication of possible animals inhibitant in the site.

In the following, there is an evaluation of literature review of treatment of contaminated soil using references obtained from Dan.

Continued on Page

Read and Understood By

R. Mahan 4/8/92 _____ _____
Signed Date Signed Date

PROJECT HARCO

NOTEBOOK NO. [illegible]

Continued From Page 1

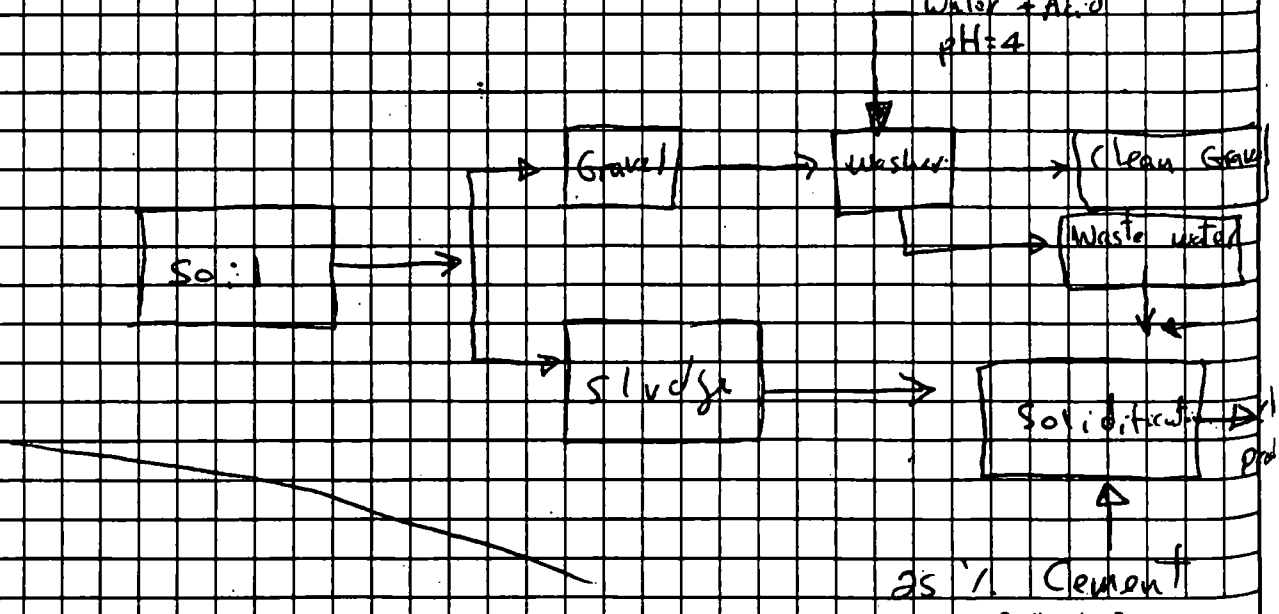
~~Contaminants that may be exist in the HARCO waste.~~

Samples from HARCO site were analyzed from NEAL in oct. 1990 for the following:

- Cyanide, total metals, volatile Organic Compounds Base/neutral & Acid- Extractable Compounds

Lead exist in large Concentration >> 10,000 PPM

The Proposed Technology for this waste is Solidification. First, gravel will be separated from sludge and washed. Sludge will be solidified



Continued on Page

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Complimentary [illegible] concerns

1) Run off water control

2) Evaluation of any organics or volatiles → Emission Control

3) Selection of acid as HNO_3 so that no further harm will be done to the soil.

Discussion with Dan

$/Ton → solidification } $/Project Clean Gravel

$/Ton → Disposal

Make calls to check the details of cost estimates to handle the project.

The pH of 4 is not recommended therefore a search for an appropriate surfactant must be performed and cost analysis must be done.

In the following there is a description of the operating procedure for separation of gravel from sludge.

Continued on Page

NOTEBOOK NO.

PROJECT

Continued From Page 3

one of the four buckets is opened (#1) labled HARCO 1. The physical appearance of the soil is as follows:

- Some Rocks can clearly observed
- Some stones (Large sized stones) are also observed
- The sludge is continuous water and is very saturated
- Couple scoops are taken out for analysis

The sample obtained for separating didn't contain soil & water and only little pieces of stones.

So about 500.7 grams are used for the 1st steps of process.

A 4 mm opening sieve is used and the sample is placed inside the sieve. The agitator (shaker) is set at NORMAL sieving) Timing 10 min but even then the sludge was still on the sieve increase the timing to 30 min.

then the time was increased another 10 min.

TOTAL Time = 50 min

Continued on Page

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Sludge = 2959 g

Solid = 178.62

Waste cleaned with 10% Nitric acid and placed on top of bench next to solid = 25.5 g

Samples were placed in the cabinet next to computer Table and labeled accordingly HARCO samples Samples are placed in ziplock bags in order to the side to examine the Area.

Continued on Page

Read and Understood By

Signed — Date — Signed — Date

4/9/02

PROJECT _____ Continued From Page _____

4-10-92

Took approximately 1 kg of wet sample from each sample and dried in oven at 105°C over night then using soil grinder ground each sample and sieved into three portions and weighed each: (see table below)

Sample #	Total wt (g)	(9.5mm) wt (g) < 3/8"	% of Total	(9.5-16mm) wt (g) >3/8 < 5/8	% of Total	16mm wt (g) > 5/8	% of Total	Maximum Gravel size (cm)
#1	942.8	663.19	70.3	16.25	1.72	263.36	27.9	9.0
#2	929.57	875.1	94.1	20.02	2.15	34.45	3.70	3.5
#3	848.71	646.83	76.2	18.65	2.20	183.23	21.6	6.2
#4	712.59	599.83	84.2	10.66	1.50	102.10	14.3	5.0

* NOTE. sample contained large coarse gravel > 3"

4-13-92 = Set up solidification on samples by first portioning out approx 1800g of sample into a pie dish allowing the soil to settle and pouring off the excess water ~~Note~~ three of the four samples were very wet a percent solids was run on each sample to determine the water content when solidified other than pouring off the water that rose to the top and screening for < 1/4" nothing else was done to the sample before adding cement.

To each sample 15%, 30% + 45% portland type I cement was added based on wet weight of the sample + water was then added if needed (see table)
the samples were then mixed thoroughly placed in solidification forms and cured at ~107°F for seven days

Continued on Page

Read and Understood By:

Signed _____ Date _____ Signed _____ Date _____

PROJECT

Dar

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#

#

#

#

#

%

Sumple

#1

#2

#3

#4

Sample	cement %	wt (g) of cement	ml of DI Added	wet sample wt (g)
#1	15	90	30	600
#1	30	180	46	600
#1	45	270	86	600
#2	15	99	0	660
#2	30	201	0	670
#2	45	305	0	679
#3	15	105	0	702
#3	30	210	0	700
#3	45	315	0	699
#4	15	90	0	600
#4	30	180	0	600
#4	45	270	0	600

% solids Run on Samples (as used in solidification)

Sample	Dish (g)	wet sample dish	dry sample dish	% solid	% moisture
#1	2.88	33.60	28.27	82.6	17.4
#2	2.89	47.34	27.50	55.4	44.6
#3	2.88	60.26	38.22	61.6	38.4
#4	3.03	43.26	25.95	57.0	43.0

Dried overnight at 105°C

Continued on Page

Read and Understood By

Signed Date Signed Date

NOTEBOOK NO._____

PROJECT_____

Continued From Page_____

4-20-92 Removed solidification samples from curing chamber at ~9:00 Am
Total Time in curing chamber at 107°F = 161 hr = ~6.7 day

Left out to dry after Removing Nast-Z Tube = 27 hr at ~65°F

To the samples I used the the Pocket concrete penetrometer only on samples which were to be used for TCLP (the samples were still in the plastic mold).

Sample			PSI at Time of Penetration		
#1	1	15%	—	> 700	
		30%	—	> 700	
	2	45%	—	> 700	
	2	15%	—	> 700	- Slight Penetration
	3	30%	—	> 700	
		45%	—	> 700	
	3	15%	—	> 700	- Slight Penetration
		30%	—	> 700	
		45%	—	> 700	
	4	15%	—	650	- Total Penetration
		30%	—	> 700	- Slight Penetration
		45%	—	> 700	

Continued on Page

Read and Understood By

Signed Date Signed Date

4-21-92 Ran unconfined compression test on the Hanco solidification samples. Did not run the test on sample # 4 15%, nor # 4 30% these samples were obviously too soft the other samples were run using either the large proving ring or the small ring depending on their suspected strength.

After each sample was tested for ucs it was crushed and 100g was placed in a TCLP extraction bottle with 2l of extraction fluid #2 and tumbled for 18 hr to be filtered and analyzed for metals to determine leachability

4-22-92 TCLP tumbling stopped after 18 hr and samples filtered through 0.7 µ glass fiber paper.

The following is a list of the TCLP samples and their Sample Numbers and description (see pg 7 for weights used in solidification)

Description — Sample #		Description — Sample #	
# 1-15%	— A13316	# 3-15%	— A13322
1-30%	— A13317	3-30%	— A13323
1-45%	— A13318	3-45%	— A13324
# 2-15%	— A13319	# 4-15%	— A13325
2-30%	— A13320	4-30%	— A13326
2-45%	— A13321	4-45%	— A13327
COC # 96887		Extraction Blank	— A13328

Shot rock sample

on Page

Continued on Page

Read and Understood By

Signed Date Signed Date

ASTM D-2488-69

4-23-92 Classification (OBSERVATION) visual manual

Sample # Particle size, major component, minor component color, odor, moisture, density consistency

1

Particle size = By dry screening = 70% of sample is < 3/8", 1.7% > 3/8" and < 5/8", 28% > 5/8"

THROUGH OBSERVATION — Medium Sand - Fine gravel + (coarse Gravel)

COLOR = uniform = Dark Reddish Brown with flecks of mica

odor = None ~~Earthy~~

Moisture = Moist

Consistency = SOFT

Remarks = poorly graded Soil with coarse Gravel (shaped)

coarse angular

2. Particle size By dry screening
94% = < 3/8", 2% > 3/8" + < 5/8", 3.7% > 5/8"

OBSERVATION — Fine Sand, coarse Gravel, medium Sand

Color = Yellowish Red, with Yellow and Black specks clumps throughout

odor = Earthy

Moisture = wet

consistency = medium stiff

Remarks = some roots + twigs rounded shaped gravel

Continued on Page

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Signed Date Signed Date

Notebook No. 1

PROJECT

Continued From Page

3 Particle size through dry sieving

76% < 3/4", 2.2% 7/8 + < 5/8, 21.6% 7 5/8"

observation = medium sand + course Gravel

color = Reddish Brown,

odory = slight Earthy

moisture = wet, water puddles on top of soil

consistency = V-soft due to wetness

Remarks = water puddles on TOP OF sample and some organic ROOTS + Twigs, Regular shaped Gravel

4 = Particle size By Dry Sieving

94% < 3/8", 1.5% 7 3/8 + < 5/8, 14% 7 5/8

observation = Coarse Sand, Fine Sand, Some Irregular shaped course Gravel

color = Black sand, Grey And white Gravel

odor =

moisture = very wet, PUDDLE TO surface

~~consistency~~ = ~~soft~~ consistancy Firm

Remarks = Irregular and Shaped gravel of metalic Appearance course Gravel & a conglomerate of Sand

Some ROOTS

Continued on Page

Read and Understood By

Signed Date Signed Date

4-27-92 Ran TCLP on Raw Sample 1-TRG 4 4 using 100g sample for 2l of extraction fluid #2 The raw sample was screened for less than 1/4" and tumbled from 1600 4-27 To 10:00 4-28

4-28-92 Filtered TCLP samples from 4-27 Rec into 1l plastic bottles and preserved with HNO_3 Labeled and placed them in Refrigeration.

Continued on Page

Read and Understood By

Signed Date Signed Date

Appendix B

Appendix B
XRF Results
Harco Site
Wilton, Connecticut
May, 1992

XRF Results Sample #1
REAC Sample No. (15120)

Element	Value	Std. dev.	% Error
CrHI	470	240	51.1%
K	31000	560	1.8%
Ca	31000	390	1.3%
Ti	4400	180	4.1%
Mn	1000	300	30.0%
Fe	75200	960	1.3%
Ni	120	80	66.7%
Cu	380	60	15.8%
Zn	4500	130	2.9%
Sr	260	13	5.0%
Zr	250	12	4.8%
Pb	490	34	6.9%
Rb	170	13	7.6%
Sb	32	26	81.3%
Ba	720	23	3.2%
Zr	250	12	4.8%
Pb	490	34	6.9%
Rb	170	13	7.6%
Sb	32	26	81.3%
Ba	720	23	3.2%

XRF Results Sample #2
REAC Sample No. (15121)

Element	Value	Std Dev	% Error
CrHI	690	270	39.1%
K	12700	410	3.2%
Ca	65600	540	0.8%
Ti	2400	140	5.8%
Mn	340	330	97.1%
Fe	153000	1400	0.9%
Ni	280	130	46.4%
Cu	1000	100	10.0%
Zn	14500	180	1.2%
Sr	310	18	5.8%
Zr	170	12	7.1%
Pb	2000	80	4.0%
Rb	80	13	16.3%
Cd	140	93	66.4%
Sn	120	53	44.2%

XRF REsults Sample #3
REAC Sample No. (15122)

Element	Value	Std. dev	% Error
K	14000	420	3.0%
Ca	68900	550	0.8%
Ti	2800	150	5.4%
Mn	1400	370	26.4%
Fe	145000	140	0.1%
Ni	210	120	57.1%
Cu	1800	130	7.2%
Zn	15000	280	1.9%
Sr	200	15	7.5%
Zr	230	13	5.7%
Pb	2500	87	3.5%
Rb	76	13	17.1%
Cd	160	94	58.8%
Sn	140	53	37.9%
Ba	430	22	5.1%

XRF Results Sample #4
REAC Sample No. (15075)

Element	Value	Std. dev.	
CrHI	690	290	42.0%
K	13000	430	3.3%
Ca	57600	540	0.9%
Ti	2000	120	6.0%
CrLO	180	90	50.0%
Mn	1300	280	21.5%
Fe	18800	460	2.4%
Co	350	170	48.6%
Cu	630	94	14.9%
Zn	152000	870	0.6%
Sr	230	19	8.3%
Zr	120	13	10.8%
Pb	15500	250	1.6%
Rb	44	16	36.4%
Cd	230	110	47.8%
Sb	46	40	87.0%
Ba	260	21	8.1%